

# **Design Guide for Hardening Wastewater Treatment Facilities against Flooding from Surge, Sea Level Rise, and Extreme Rainfall**

Prepared for  
**Miami-Dade Water and Sewer Department**

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## Purpose and Background

This document summarizes elevations below which wastewater treatment facility assets should be protected or hardened to withstand or recover from flooding from projected future combinations of storm surge from tropical storms and hurricanes, coupled with extreme rainfall and sea level rise (SLR) at each of the Miami-Dade Water and Sewer Department's three wastewater treatment plants (WWTP): North District (NDWWTP), Central District (CDWWTP), and South District (SDWWTP).

The design elevations selected by WASD are different for existing and for new facilities, as summarized below. The basis of these recommendations is detailed in separate documents (see references below). In short, the design criteria for existing facilities are based on the FEMA Base Flood Elevation (BFE) at CDWWTP and SDWWTP (10.0 ft. NGVD29), with an allowance for 3.0 ft. of SLR, 2.0 ft. of freeboard, and 1.0 ft. of safety factor, and no rainfall, which totals 16.0 ft. The design criteria for existing facilities at NDWWTP selected by WASD will also be 16.0 ft., though the FEMA BFE is there is 2 ft. lower, at 8.0 ft. For new facilities more recent estimates of surge coupled with sea level rise and extreme rainfall are used at each of the WWTPs, with 4.0 ft. of SLR, 2.0 ft. of freeboard, and 1.0 ft. of safety factor. The SLR and precipitation estimates are based on high projections for 2075.

These estimates may be revised periodically as information on storm surge, sea level rise and extreme precipitation projections is revised.

## WASD Level of Service Priorities for Facility Resilience during Extreme Events

WASD has adopted a risk-based framework to guide the design of wastewater facilities for these extreme events, which recognizes that they are low probability, but potentially high consequence if systems fail. To guide the elevation and type of facility hardening measures that engineers should consider when design flood protection or recovery measures, WASD has set the following ranking of processes to be protected, in declining order:

1. Personnel protection and hydraulic capacity maintained.
2. Primary treatment liquid processes
3. Secondary treatment liquid processes
4. Solids treatment processes

## Design Elevations for Existing and New Facilities

Table 1 summarizes the design flood elevations for existing and new facilities at the 3 WWTPs. Figures 1, 2, and 3, summarize the flood elevations graphically for NDWWTP, CDWWTP, and SDWWTP, respectively, along with critical existing assets.

**Table 1**  
**WWTP Summary of Design Criteria for Hardening against Flooding from Surge, Sea Level Rise and Extreme Storm Events.**

	Existing WWTP Facility Assets		New WWTP Facility Assets	
	ft. NGVD29	Basis	ft. NGVD29	Basis
<b>CDWWTP</b>	16.0	FEMA BFE + 3ft SLR from SEFLCC(2011) +FB +SF	20.3	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)
<b>SDWWTP</b>	16.0	FEMA BFE + 3ft SLR from SEFLCC(2011) +FB +SF	19.0	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)
<b>NDWWTP</b>	16.0	Same as CDWWTP and SDWWTP	17.1	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)

FB= Freeboard = 2.0 ft. per ASCE Standard 24-05/2010 FBC Category IV

SF= Safety Factor = 1.0 ft. per 2014 MWH study at CDWWTP

SLR = 1.23m = 48" per NOAA High projection for 2075 (USACE High projection is 0.93m)

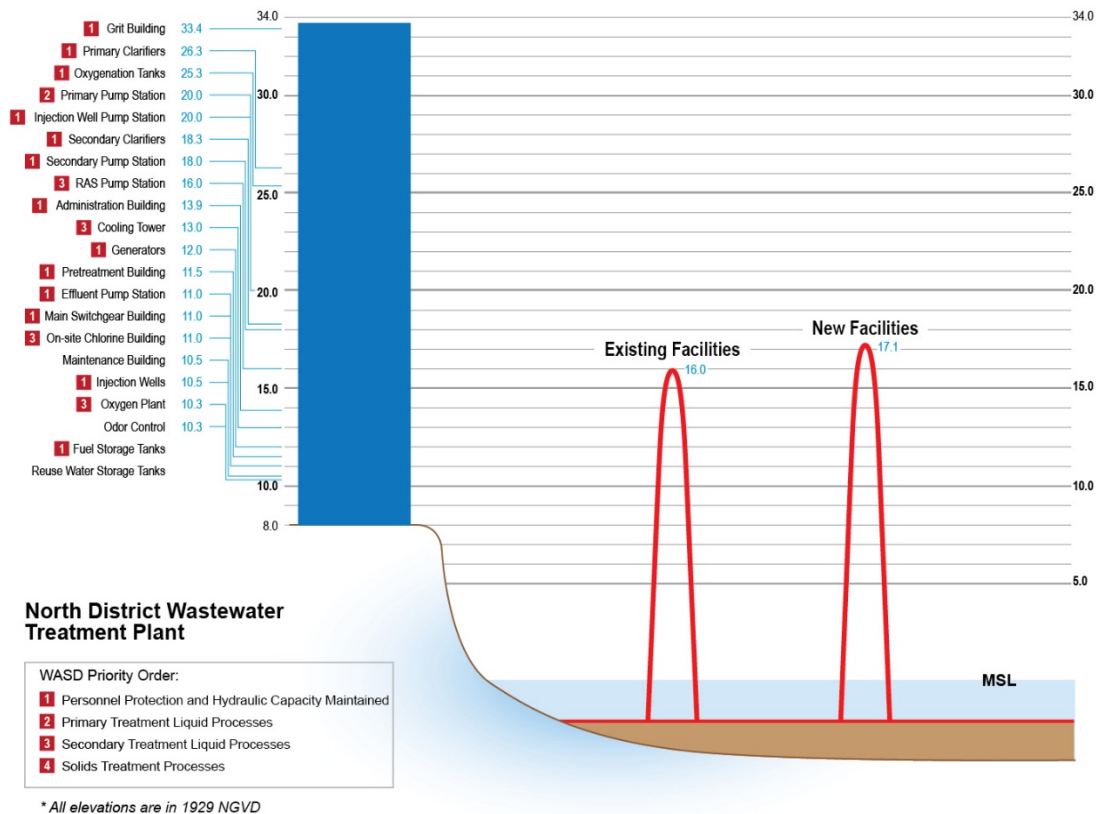


Figure 1. Facility Hardening Design Elevations and Prioritization of Critical Facilities for North District Wastewater Treatment Plant.

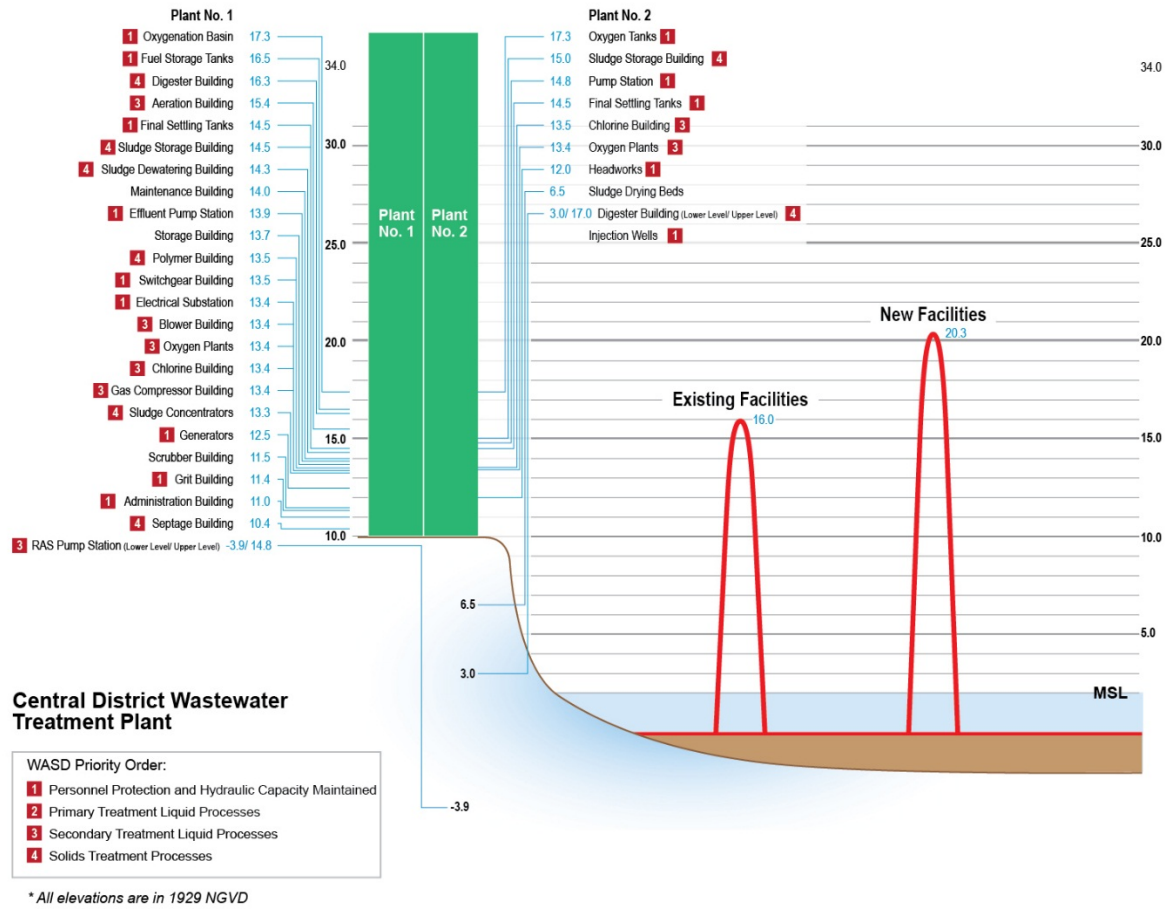


Figure 2. Facility Hardening Design Elevations and Prioritization of Critical Facilities for Central District Wastewater Treatment Plant.

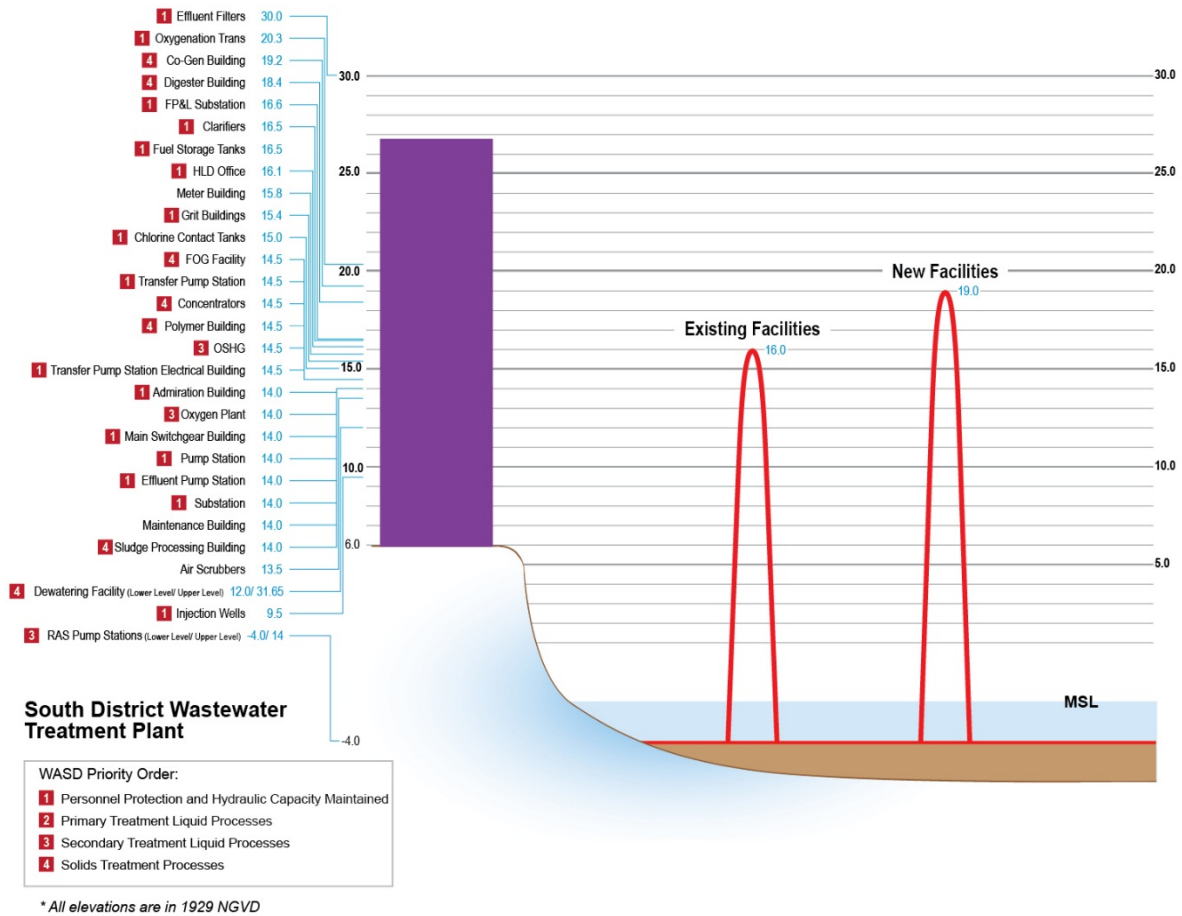


Figure 3. Facility Hardening Design Elevations and Prioritization of Critical Facilities for South District Wastewater Treatment Plant.

## Facility Hardening Approaches

To protect assets against flooding from extreme events, design engineers should evaluate facilities and structures to understand flood pathways that can lead to critical systems such as power sources, electrical and mechanical systems, motors and pumps. Flood pathways include but are not limited to doors, windows, areaways, tunnels, grates, conduits, manholes or other wall penetrations. Those locations should be identified as at-risk if threshold elevations are below the assigned flood elevation in Table 1.

Figure 4 lists facility hardening measures that can be considered by design engineers, based on criticality of the facilities relative to WASD level of service goals stated above.












Adaptation Strategy	Resiliency/Effectiveness	Cost
	<b>Elevate Equipment</b> On pads or platforms, to a higher floor, to the roof, or to a new elevated building.	 SSSS
	<b>Flood-Proof Equipment</b> By replacing pumps with submersible pumps and installing watertight boxes around electrical equipment.	 SSS
	<b>Install Static Barrier</b> Across critical flood pathways or around critical areas.	 SSS
	<b>Seal Building</b> With water-tight doors and windows, elevating vents and secondary entrances for access during a flood event.	 SS
	<b>Sandbag Temporarily</b> Around doorways, vents, and windows before a surge event.	 \$
	<b>Install Backup Power</b> Via generators nearby or a plug for a portable generator.	<i>Does not protect equipment but facilitates rapid service recovery.</i> SSS

Figure 4. Facility Hardening Approaches. (Source: NYCDEP, 2013)

## References

CH2M HILL (CH2M). 2015. *Surge and Flood Modeling for Miami-Dade County*. Ocean Outfall Legislation Program, Miami-Dade Water and Sewer Department. April.

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MWH. 2014. *Central District Wastewater Treatment Plant Engineering Approach for Climate Adaptation and Resiliency*.

New York City Department of Environmental Protection. 2013. *Wastewater Resiliency Plan, Climate Risk Assessment and Adaptation Study*. Prepared by CH2MHILL – Hazen and Sawyer Joint Venture.